PATENT
ATTORNEY DOCKET NO. 0092/020001

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Nobuhiko OOHARA et al. Art Unit: 1626
U.S. Patent No. 7,411,096 Examiner: Nolan, J.
Date of Patent: August 12, 2008 Application No.: 10/564,985
Filed : January 18, 2006
Title : PROCESS FOR PRODUCING OPTICALLY ACTIVE PHOSPHORUS HETEROCYCLIC DIMER

ATTENTION: CERTIFICATE OF CORRECTIONS BRANCH
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

REQUEST FOR CERTIFICATE OF CORRECTION

Sir:

In reviewing the above-identified patent, a printing error was discovered therein requiring correction in order to conform to the Official Record in the application.

The error noted is set forth on the attached copy of Form PTO/SB/44 (09-07) in the manner required by the Commissioner's Notice.

Upon reviewing the patent it was noted that in claim 1, line 40, found at column 23, "$Y\text{-}C_nH_{2n\text{-}Y}$" should be deleted and the following formula added in its place --$Y\text{-}C_nH_{2n}\text{-}Y$--.

It is submitted that no fee is necessary for this request, as this error was incurred by the U.S. Patent and Trademark Office (USPTO). Please see the enclosed copy of the Amendment under 37 CFR 1.111 filed on March 26, 2008, resulting in the

Notice of Allowance and Notice of Allowability dated June 2, 2008. If the USPTO determines that it is necessary to charge the Certificate of Correction fee, the USPTO staff person in charge of this issue should contact the undersigned to discuss obtaining authorization to charge this fee to our Deposit Account.

Accordingly, applicants respectfully request the USPTO to issue the Certificate of Correction for this patent.

If there are any questions regarding this application, please telephone the undersigned at the telephone number listed below.

Respectfully submitted,

Date: September 16, 2008

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PTO/SB/44 (09-07)
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 7,411,096

APPLICATION NO.: 10/564,985

ISSUE DATE : August 12, 2008

INVENTOR(S) : Nobuhiko OOHARA et al.

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 23

in claim 1, line 40 "$Y\text{-}C_nH_{2n\text{-}Y}$" should read -- $Y\text{-}C_nH_{2n}\text{-}Y$ --

MAILING ADDRESS OF SENDER (Please do not use customer number below):

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

(Also Form PTO-1050)

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

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Column 23

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Nobuhiko OOHARA et al. Art Unit: 1626
Application No.: 10/564,985 Examiner: Nolan, J.
Filed : January 18, 2006
Title : PROCESS FOR PRODUCING OPTICALLY ACTIVE PHOSPHORUS HETEROCYCLIC DIMER

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT UNDER 37 CFR 1.111

Sir:

In response to the Office Action dated December 28, 2007, please amend the application as follows:

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims begin on page 5 of this paper.

Remarks begin on page 8 of this paper.

AMENDMENTS TO THE SPECIFICATION

Please substitute the paragraph beginning at page 61, line 2 and ending at page 62, line 8 to read as follows:

-- The present invention provides a process for producing an optically active phosphorus heterocyclic dimer including reacting, in the presence of a base, ~~Primary~~ primary phosphine represented by formula (1):

~~[Chem. 1]~~

R-PH_2 **(1)**

~~(wherein R represents a linear, branched, or cyclic alkyl group having 2 to 20 carbon atoms)~~ is reacted with a compound represented by formula (2):

~~[Chem. 2]~~

Y-C_nH_{2n}-Y **(2)**

~~(wherein Y represents a halogen atom or a leaving group selected from --OTs, --OTf, and --OMs, and n represents a number of 3 to 6)~~ in the presence of a base; the product is reacted with boron

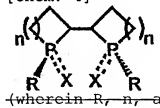
trihydride, oxygen, or sulfur to obtain a phosphorus heterocyclic compound represented by formula (3):

~~[Chem. 3]~~

(3)

~~(wherein R represents the same as the above, n represents a number of 1 to 4, X represents a boron trihydride group, an oxygen atom, or a sulfur atom, and === represents a single bond when X is a boron trihydride group or a double bond when X is an oxygen atom or sulfur atom);~~ the resultant compound is dimerized to produce a phosphorus heterocyclic dimer represented by formula (4):

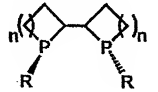
~~[Chem. 4]~~



(4)

~~(wherein R, n, and X represent the same as the above);~~ and then oxygen, sulfur, or borane is removed from the resultant phosphorus heterocyclic dimer to obtain an optically active phosphorus heterocyclic dimer represented by formula (5):

~~[Chem. 5]~~



(5)

~~(wherein R and n represent the same as the above)~~. --

AMENDMENTS TO THE CLAIMS

Please substitute the following claims for the pending claims with the same numbers respectively:

Claim 1 (Currently amended): A process for producing a phosphorus heterocyclic dimer according to formula (5) comprising the steps of:

reacting, in the presence of a [[base]] n-butyl lithium, primary phosphine represented by formula (1):

~~[Chem. 1]~~

$$R\text{-}PH_2 \qquad (1)$$

(wherein R represents a linear [[,]] or a branched~~, or cyclic~~ alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms) with a compound represented by formula (2):

~~[Chem. 2]~~

$$Y\text{-}C_nH_{2n}\text{-}Y \qquad (2)$$

(wherein Y represents a halogen atom or a leaving group selected from -OTs, -OTf, and -OMs, and n represents a number of 3 to 6);

reacting [[the]] a product , which was obtained by said step of reacting primary phosphine represented by formula (1) with a compound represented by formula (2), with boron trihydride, oxygen, or sulfur to obtain a phosphorus heterocyclic compound represented by formula (3):

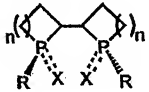
~~[Chem. 3]~~

(3)

(wherein R represents ~~the same as the above~~ a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms, n ~~represents a number of~~ equals 1 ~~to 4~~, X represents a boron trihydride group, an oxygen atom, or a sulfur atom, and === represents a single bond when X is a boron trihydride group or a double bond when X is an oxygen atom or sulfur atom);

dimerizing the ~~resultant compound~~ phosphorus heterocyclic compound represented by formula (3) to produce a phosphorus heterocyclic dimer represented by formula (4):

~~[Chem. 4]~~

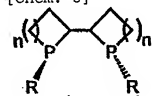


(4)

(wherein R ~~, n, and X represent the same as the above~~ represents a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms, n equals 1, X represents a boron trihydride group, an oxygen atom, or a sulfur atom); and [[then]]

removing oxygen, sulfur, or borane from the ~~resultant~~ phosphorus heterocyclic dimer represented by formula (4) to obtain an optically active phosphorus heterocyclic dimer represented by formula (5):

~~[Chem. 5]~~



(5)

(wherein R ~~and n represent the same as the above~~ represents a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms, n equals 1); and

wherein said step of reacting the primary phosphine represented by formula (1) with the compound represented by formula (2) includes using 1,3-dichloropropane as the compound represented by formula (2).

REMARKS

By this amendment, the specification has been editorially amended and claim 1 has been amended in the application. Currently, claim 1 is pending in the application.

Claim 1 was objected to because of the following informalities: the Examiner stated that the preamble of the claim should read, "A process for producing a phosphrus heterocyclic dimer according to formula 5 ..." to clarify the scope of invention. By this amendment, independent claim 1 has been amended as the Examiner suggested. It is respectfully submitted that this objection has been overcome by this amendment and it should be withdrawn.

Claim 1 was rejected under 35 USC 103(a) as being obvious over Zhang et al. (U.S. Patent No. 7,169,953) in view of Ohashi et al. (Heterocycles 2000, Vol. 52, No. 2, Pages 905-910).

This rejection is respectfully traversed in view of the amendments to claim 1 and the remarks below.

The present invention relates to a process for producing an optically active phosphorus heterocyclic dimer (see page 1, lines 5-6 of the specification).

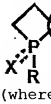
The present invention provides a process for producing an optically active phosphorus heterocyclic dimer including reacting, in the presence of n-butyl lithium, primary phosphine represented by formula (1):

$$R\text{-}PH_2 \qquad (1)$$

(wherein R represents a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms) with a compound represented by formula (2):

$$Y\text{-}C_nH_{2n}\text{-}Y \qquad (2)$$

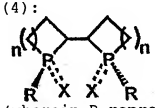
(wherein Y represents a halogen atom or a leaving group selected from --OTs, --OTf, and --OMs, and n represents a number of 3 to 6); reacting the product with boron trihydride, oxygen, or sulfur to obtain a phosphorus heterocyclic compound represented by formula (3):



(3)

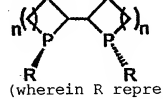
(wherein R represents a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms, n equals 1, X represents a boron trihydride group, an oxygen atom, or a sulfur atom, and === represents a single bond when X is a boron trihydride group or a double bond when X is an

oxygen atom or sulfur atom); dimerizing the resultant compound to produce a phosphorus heterocyclic dimer represented by formula (4):



(4)

(wherein R represents a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms, n equals 1, X represents a boron trihydride group, an oxygen atom, or a sulfur atom); and then removing oxygen, sulfur, or borane from the resultant phosphorus heterocyclic dimer to obtain an optically active phosphorus heterocyclic dimer represented by formula (5):



(5)

(wherein R represents a linear or a branched alkyl group having 2 to 20 carbon atoms or a cyclic alkyl group having 3 to 20 carbon atoms, n equals 1) (see page 4, line 3 - page 5, line 16 of the specification).

An example of the compound represented by formula (2) includes 1,3-dichloropropane (see page 8, lines 15-16 of the specification).

By this amendment, independent claim 1 has been amended to recite "said step of reacting the primary phosphine represented by formula (1) with the compound represented by formula (2) includes using 1,3-dichloropropane as the compound represented by formula (2)". This feature is not shown or suggested by Zhang et al. and Ohashi et al.

Zhang et al. relate to novel chiral ligands derived from P-chiral phospholanes and P-chiral phosphocyclic compounds and catalysts for applications in asymmetric catalysis. More particularly, Zhang et al. relates to transition metal complexes of these chiral phosphine ligands, which are useful as catalysts in asymmetric reactions, such as, hydrogenation, hydride transfer, hydrocarboxylation, hydrosilylation, hydroboration, hydrovinylation, hydroformylation, allylic alkylation, olefin metathesis, isomerization, cyclopropanation, Diels-Alder reaction, Heck reaction, Aldol reaction, Michael addition, epoxidation, kinetic resolution and [m + n] cycloaddition (see col. 1, lines 17-28).

Zhang et al. disclose several procedures to prepare the chiral ligands that are described on column 24, line 45 - column 27, line 45.

Zhang et al. do not disclose that the step of reacting the primary phosphine represented by formula (1) with the compound represented by formula (2) includes using 1,3-dichloropropane as the compound represented by formula (2) as claimed in independent claim 1.

Applicants respectfully submit that Zhang et al. do not teach or suggest the specific reaction as claimed in claim 1, since the step of producing the four-membered phosphetanes is not disclosed.

For these reasons, it is believed that Zhang et al. do not show or suggest the present claimed features of the present invention. Applicants also submit that Ohashi et al. do not make up for the deficiencies in Zhang et al.

Ohashi et al. relate to synthesis of 1-adamantylphosphine and its use in the synthesis of cyclic phosphines containing 1-adamanthyl group.

Ohashi et al. disclose that 1-adamanthylphosphine (1) was easily synthesized by treating 1-adamantylmagnesium bromide with PC13, followed by reduction with $LiAlH_4$. Several new cyclic trialkylphosphines bearing a 1-adamantyl group were prepared from compound 1. Thus, treating 1 with BuLi and $TsOCH_2(CH_2)nCH_2OTs$ (n = 1, 2), followed by BuLi and BH_3-THF gave 27 - 39% of the

corresponding 1-adamantyl-substituted phosphetane-borane or phospholane-borane (see abstract).

Ohashi et al. do not disclose that the step of reacting the primary phosphine represented by formula (1) with the compound represented by formula (2) includes using 1,3-dichloropropane as the compound represented by formula (2) as claimed in independent claim 1.

Applicants respectfully submit that even though Ohashi et al. disclose a process of producing a four-membered phosphetane, Ohashi et al. discloses the use of $TsOCH_2(CH_2)nCH_2OTs$. In this case, the use of $TsOCH_2(CH_2)nCH_2OTs$ (n = 1) in Ohashi et al. leads to a yield of only 27 - 39%. On the other hand, 1,3-dichloropropane is used in the present invention and it is possible to obtain a yield of 48 - 59% (see page 44-46, and Examples 1 and 2 of the specification).

Therefore, applicants respectfully submit that Zhang et al. and Ohashi et al. do not teach, suggest or disclose the advantageous effect of using 1,3-dichloropropane as claimed in claim 1.

It is therefore respectfully submitted that Zhang et al. and Ohashi et al., individually or in combination, do not teach, disclose or suggest the presently claimed invention and it would

not have been obvious to one of ordinary skill in the art to combine these references to render the present claims obvious.

In view of the foregoing claim amendments and remarks, it is respectfully submitted that the application is now in condition for allowance and an action to this effect is respectfully requested.

If there are any questions or concerns regarding the amendments or these remarks, the Examiner is requested to telephone the undersigned at the telephone number listed below.

Respectfully submitted,

Date: March 26, 2008

Randolph A. Smith
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